BARENBLATT, G. I.

Barenblatt, G. I. On certain problems of the theory of elasticity that arise in the investigation of the mechanism of hydraulic rupture of an oil-bearing layer. Prikl. Mat. Meh. 20 (1956), 475–486. (Russian)

1-FW

2

SUBJECT USSR/MATHEMATICS/Differential equations CARD 1/2 PG - 680
AUTHOR BARENBLATT G.Y.
TITLE On auto-model solutions of the Cauchy problem for non-linear parabolic equations of a non-stationary gas filtration in a porous medium.
PERIODICAL Priklad.Mat.Mech. 20, 761-763 (1956) reviewed 4/1957

For a non-stationary axial-symmetric isothermal gas filtration in a porous medium the gas pressure p satisfies the equation

$$\frac{\partial p}{\partial t} = a^2 \frac{1}{r} \frac{\partial}{\partial r} r \frac{\partial p^2}{\partial r} . \quad (1)$$

Here t is the time, r the distance from the symmetry axis of the flow, a is a constant which depends on the properties of the gas and of the porous medium. The author investigates the auto-model solutions of the Cauchy problem for (1). These solutions satisfy the initial conditions

$p(r,0) = \sigma r^{\alpha}$ with constant $\sigma, \alpha > 0$

and furthermore the condition $\left(\frac{\partial p}{\partial r} \right)_{r=0} = 0.$

Priklad.Mat.Mech. 20, 761-763 (1956) CARD 2/2 PG - 680

It is proved that, for $0 < \alpha < 2$, the solution exists for all t in the interval $0 \leq t < \infty$ and that it can be obtained as the solution of the Cauchy problem for a certain simple differential equation of second order. For $\alpha = 2$ the solution exists only for $0 \leq t < T$, $T = 1/16a^2\sigma$. For $\alpha > 2$ the solution of the Cauchy problem becomes non-unique. This ambiguity corresponds to the ambiguity of the solution of a certain boundary value problem for an ordinary differential equation.
The behavior of the solutions is analogous to the results of Hopf for the equation $u_t + uu_x = cu_{xx}$ (Comm.Pure Appl.Math. 3, (1950)).

INSTITUTION: Petroleum Institute, Acad.Sci., Moscow.

BARENBLAT, G. I.

2720. EXPANSION OF A COKE CHANNEL DURING TREATMENT OF COAL WITH AN
ELECTRIC CURRENT. Barenblatt, G.I. (Dokl. Akad. Nauk SSSR (Rep. Acad. Sci.
U.S.S.R.), 11 May 1956, vol. 108, (2), 230-242). A mathematical treatment of
experimental work at the Institute of Combustible Minerals, U.S.S.R. A small
hole is drilled in a block of unmined coal, or in a layer of a coking charge,
and filled with coke. Voltage is applied to the two ends of this coke channel
and a current flows through the coke, which has much higher conductivity than
the surrounding coal. The heat produced converts the coal into low
temperature coke so that it also conducts current. (L).

BARENBLATT, G. I. Doc Phys-Math Sci -- (diss) "Certain problems of the hydrodynamic theory of nonstationary filtrations." Mos, 1957. 15 pp 22 cm. (Acad Sci USSR. Inst of Petroleum), 150 copies. (KL, 13-57, 96)

11(0); 14(0) PHASE I BOOK EXPLOITATION SOV/1770

Barenblatt, G.I.

Nekotoryye zadachi gidrodinamicheskoy teorii nestatsionarnoy fil'tratsii; avtoreferat dissertatsii, predstavlennoy na soiskaniye uchenoy stepeni doktora fiziko-matematicheskikh nauk (Some Problems Connected with the Hydrodynamic Theory of Nonstationary Filtration; Abstract of a Dissertation Offered for the Degree of Doctor of Physical and Mathematical Sciences) Moscow, izd-vo AN SSSR, 1957. 14 p. 150 copies printed.

Sponsoring Agency: Akademiya nauk SSSR. Institut nefti

PURPOSE: The booklet is intended for scientists studying hydromechanical problems connected with the subterranean nonstationary filtration of fluids and gaseous substances.

COVERAGE: In this booklet, which is an abstract of the dissertation presented by the author for a degree of Doctor in Physical and Mathematical Sciences, he discusses various problems of sub-

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terranean hydromechanics and offers their solutions. He states that the theory of filtration was first developed in connection with studies of subsurface water migration, a theory still considered as one of the most important in subterranean hydromechanics. Due to the increasingly growing demand for liquid and gaseous fuels, an additional branch of subterranean hydromechanics, petroleum hydromechanics, was developed in the Twenties and Thirties. It became the basis of a modern concept of efficient oil reservoir exploitation. Problems of the hydromechanical theory of nonstationary filtration have been studied by a great number of Soviet scientists. The dissertation was completed by the author in 1956. It consists of four chapters. The first chapter is a brief review of the basic problems of gas filtration and pressureless filtration of subsurface waters. It is based primarily on gas filtration, but in a few cases it has been found more convenient to base it on subsurface water filtration. Problems of nonstationary filtration are discussed in terms of nonlinear differential equations of a parabolic type. The first accurate solutions of such problems were given in the works of Zh. Bussinesk, L.S. Leybenzon, M. Muskat, P.Ya. Polubarinova-Kochina, and others. The second chapter of the dissertation offers accurate solutions of problems of nonstationary filtration. It contains a review of the study on the filtering motion of uniformly propagated waves by an arbitrary correlation of the filtering gas density and pressure. The author also offers accurate automodel solutions of nonstationary filtration problems. To simplify his explanations, the author confines the dissertation to reviewing problems of isometric filtration of gas and pressureless filtration of ground waters, analyzed approximately as prescribed in the works of Zh. Bussinesk. Basically, his work deals with automodel motions, the initial pressure of which is not identical to zero. The most important axially-symmetrical problem, corresponding to permanent initial pressure of gas in an endless bed, is investigated. The analysis of calculations made proves that in respect to the most important parameters of gas and environments, the solution of nonlinear problems accurately correspond to solutions of linear problems in all fields of motions. The third chapter of the dissertation is devoted to an approximate solution of problems of uniform nonstationary filtration of fluid and gas in a porous formation. The author criticizes the attempts to solve this problem on the basis of a linear equation of the heat conductivity. He finds this method inadequate and proposes the application of the approximation methods of nonstationary filtration. He discusses the association of the theory of the boundary formation to the theory of uniform nonstationary filtration. The fourth chapter contains an exposition of the general problem and solutions of some specific problems of nonstationary filtration in an inelastic porous formation. In conclusion the author indicates papers in which results of his study have been published. There are no other references.

TABLE OF CONTENTS: None Given

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TM/ad
6-18-59

BARENBLATT G.I.

24-11-11/31

AUTHORS: Barenblatt, G.I. Borisov, Yu. P., Kamenetskiy, S. G. and
Krylov, A. P. (Moscow)

TITLE: On determining the parameters of an oil bearing stratum from data of the pressure build-up in stopped wells. (Ob opredelenii parametrov neftenosnogo plasta po dannym o vosstanovlenii davleniya v ostanovlennykh skvazhinakh)

PERIODICAL: Izvestiya Akademii Nauk SSSR, Otdeleniye Tekhnicheskikh Nauk, 1957, No.11, pp.84-91 (USSR)

ABSTRACT: In this paper a method is described of determining the parameters of the stratum and the well from the initial section of the bottom-hole pressure build-up characteristic. The method is based on an accurate solution of the respective inverse problems of the theory of the elastic regime and involves calculation of the integrals of an empirical function representing the pressure build-up characteristic. The approximate calculation of the integrals is effected much more accurately than the approximate calculation of the derivatives and particularly of the second derivatives of the empirical function. The method is applicable equally to gusher wells, compressor and pump operated wells. It is shown in the paper that a

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On determining the parameters of an oil bearing stratum from data of the pressure build-up in stopped wells. 24-11-11/31

slight modification of the method permits determining the parameters of the stratum from the data of the changes in the flow rate and the pressure of the liquid at any transient regime and not only from the data on the bottom-hole pressure build-up characteristic in the stopped well. The method is also applicable to gas bearing strata. The application of the method is illustrated by two examples, one relating to data derived from model tests and another from a well with a flow rate prior to stoppage of 115 tons per day and a specific gravity of the oil in the stratum of 0.825 exploited through a 6 inch dia. column, a 2.5 inch dia. of the lifting tube with data of the pressure build-up characteristic as given in the Table, p.91.

There are 3 figures, 1 table and 17 references, 13 of which are Slavic.

SUBMITTED: June 10, 1957.

ASSOCIATIONS: Oil Institute Ac.Sc. USSR (Institut Nefti AN SSSR), All Union Scientific Oil Research Institute (Vsesoyuznyy Nauchno-Issledovatel'skiy Neftyanoy Institut)

AVAILABLE: Library of Congress.

Card 2/2

BARENBLATT, G.I.

AUTHOR: BARENBLATT, G.I., ZEL'DOVICH, Ya.B. (Moscow) 40-5-18/20

TITLE: On Solutions of Dipole Type in the Problem of the Nonsteady Filtering of Gases in the Polytropic Regime (O reshenii tipa dipolya v zadachakh nestatsionarnoy fil'tratsii gaza pri politropicheskom rezhime)

PERIODICAL: Prikladnaya Mat. i Mekh., 1957, Vol. 21, Nr 5, pp. 718-720 (USSR)

ABSTRACT: For the nonsteady filtering of gases in the polytropic regime there holds for the pressure of the gas a differential equation which, under certain indications on the initial distribution of the pressure, is equivalent to an integral equation. By this integral equation the law of the conservation of the dipole is expressed. If now, besides of the initial distribution of the pressure at the time $t = 0$, the pressure is still prescribed at one point for all times, then from the integral equation a general integral relation can be derived which gives valuable informations on the pressure distribution for arbitrary times. That range can be determined where the pressure distribution is disturbed, and the boundaries of this range can be explicitly calculated. The obtained solution is of interest particularly as an asymptotic representation of the pressure distribution. An analogy of the given solution interesting for many cases can be obtained for the case of axial-symmetric pressure

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On Solutions of Dipole Type in the Problem of the Nonsteady Filtering of Gases in the Polytropic Regime 40-5-13/20

distribution.
There are no figures, no tables, and 2 Slavic references.

ASSOCIATION: Institut nefti AN SSSR (Petroleum Institute AS USSR)

SUBMITTED: August 20, 1957

AVAILABLE: Library of Congress

Card 2/2

BARENBLATT, G.I.

AUTHOR: Barenblatt, G.I. and Zel'dovich, Ya.B.(Moscow) 40-21-6-17/18

TITLE: On the Stability of Flame Propagation (Ob ustoychivosti rasprostraneniya plameni)

PERIODICAL: Prikladnaya Matematika i Mekhanika, 1957, Vol 21, Nr 6, pp 856-859 (USSR)

ABSTRACT: The determination of the stability of flame propagation leads mathematically to the investigation of the stability of stationary solutions of the general kinetic reaction equation of diffusion and heat conduction. Such investigations were carried out by different authors. Considering the one-dimensional flame propagation Rosen [Ref 11] obtained the result that instabilities of flame propagation are possible and he gave approximation criteria for the stability. The authors show that Rosen's deductions are based on incorrect suppositions, and that the problem of the stability of flame propagation was incorrectly solved. In the present paper the stability of flame propagation is investigated under the same suppositions and it is shown, that in the one-dimensional case always exists stability. This result is valid for the pure heat propagation of the flame as well as for isothermal, chain-

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shaped flame propagations. There are 2 figures and 12 references, 7 of which are Soviet, 4 American, and 1 English.

ASSOCIATION: Institut nefti AN SSSR (Petroleum Institute, AN USSR)

SUBMITTED: August 1, 1957

AVAILABLE: Library of Congress

1. Flame propagation-Stability

BARENBLATT,

KHRISTIANOVICH, S.A.; ZHELTOV, Yu.P.; BARENBLATT, G.I.

Mechanism of hydraulic fracturing of formations. Neft.khoz. 35 no.1:44-53 Ja '57. (MLRA 10:2)

(Oil wells) (Petroleum engineering)

SOV/24-58-7-7/36

AUTHORS: Barenblatt, G. I., Maksimov, V. A. (Moscow)

TITLE: The Effect of the Nonuniformity of Oil-Bearing Strata on the Determination of their Parameters with an Unsteady Flow of Oil to the Well (O vliyanii neodnorodnostey na opredeleniye parametrov neftenosnogo plasta po dannym nestatsionarnogo pritoka zhidkosti k skvazhinam)

PERIODICAL: Izvestiya Akademii nauk SSSR. Otdeleniye tekhnicheskikh nauk, 1958, Nr 7, pp 49-55 (USSR)

ABSTRACT: The application of the Laplace transformation (Ref 3) to an unsteady oil flow to the well is considered for the case of a nonuniform oil-bearing stratum. The nonuniformity of the stratum could be caused by contamination of its boundary layers or by a geological fault at some distance from the well. It is assumed that several neighbouring wells show a constant production of oil during a sufficiently long period before the observations, so that the distribution of pressure in the stratum p_0 can be considered as constant. The thickness of stratum h is also taken as constant. The well for which the calculations are carried out has a reduced radius r_c and is surrounded by a zone of the radius R with k_1 and $\varkappa_1$ being the coefficients of porosity and piezoconductivity, respectively

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The Effect of the Nonuniformity of Oil-Bearing Strata on the Determination of Parameters with an Unsteady Flow of Oil to the Well

(k_2, $\varkappa_2$ - respective coefficients outside the surrounding zone). The calculation begins at the time $t = 0$ which could be the closing of the well when its discharge (volume) is Q_0. The measurements of the pressure and oil flow are carried out at various intervals of time. The pressure in stratum depends on the time, therefore it can be shown as a function (1.1) for $t \geq 0$ (where r, φ - polar coordinates with the origin in the centre of the well). The elastic conditions of the function $u(r, t)$ can be shown as Eq (1.2) and the initial conditions and those at the boundary of the encircling zone - as Eqs (1.3) and (1.4, 1.5), respectively. Also from Eq (1.1) the formula (1.6) can bedefined, which describes the conditions on the wall of the well ($p_c(t)$ - pressure at t, p_{co} - initial pressure). By differentiating Eq (1) in respect to r the second equation, Eq (1.7), describing the conditions on the wall is obtained, the left term of which is equal to the flow $Q(t)$ and the initial part of the right term - to the

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The Effect of the Nonuniformity of Oil-Bearing Strata on the Determination of ... Parameters with an Unsteady Flow of Oil to the Well

initial flow Q_0. Therefore, the second equation can be shown in its final form as Eq (1.8). The formulae (1.2) to (1.6), (1.8) can be solved by the application of the Laplace transformation of the function u(r, t) (top of p 51). Thus the formula (2.1) is obtained, the solution of which can be derived from Eqs (2.2) and (2.3). The transformation of the Eqs (1.4) and (1.5) can be performed when the conditions (2.4) and (2.5) are considered, while the conditions (1.6) and (1.8) will take the transformed form as Eqs (2.6) and (2.7), from which the final formula (2.8) is obtained. This can be written as Eq (2.9) when the asymptotic arguments of the Bessel function K_0 and I_0 (bottom p 51) are applied. The formula (2.9) can also be written as Eq (2.10) where the radius r_c is substituted by the radius r_c^{sr}, defined by Eq (2.11) (Ref 1). The difference between the curves obtained from Eqs (2.9) and (2.10) is shown in Fig 1, where:

$$\varphi = [(2\pi k_2 h)/Q_0 \mu] \quad \varphi(r_c)$$

Card 3/6 When the relative thickness of the surrounding zone

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The Effect of the Nonuniformity of Oil-Bearing Strata on the Determination of [illegible] Parameters with an Unsteady Flow of Oil to the Well

$\delta = (R - r_c)/r_c$ converges to 0 with such a decrease of porosity that δ/k_1 = const (Eq (2.12) m - digit) then Eq (2.10) retains its form and r_c' is found from Eq (2.13) For the large $R/\sqrt{k_1 t_c}$ the formula (2.9) takes the form (2.14). In the case of a well situated at the distance A from the straight fault (Fig 2), all the formulae shown above should be adjusted in respect to a new distance r_1 between a point (r, φ) and an imaginary well situated symmetrically in respect to the fault. Then the pressure can be calculated from Eq (3.1), the function $u(r, t)$ must satisfy the conditions (3.2) and (3.3) the condition on the wall of the well is defined by Eq (3.4) and the final formula (3.5) obtained by differentiating the Eq (3.1), the left-hand term of which is equal to Q while the first part of the right hand term is equal to Q_0. Thus by transformation the formula (3.5) is written as Eq (3.6). The solution is found by means of the

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The Effect of the Nonuniformity of Oil-Bearing Strata on the Determination of their Parameters with an Unsteady Flow of Oil to the Well

Laplace transformation (3.7) and the Eq (3.2) takes the form of Eq (2.1), while the Eqs (3.3), (3.4) and (3.6) take the forms of Eq (3.8), (3.9) and (3.10), respectively. The solution of Eq (2.1) takes the form of Eq (3.11) which, when substituted into Eq (3.9) and (3.10), becomes Eq (3.12) written also as Eq (3.13) or (3.14) or (3.15) when the ratio r_c/ℓ is equal to unity. The transition from Eq (3.14) to (3.15) as a relation of ϕ and $\ell n\, t_0$ (bottom of p 54) is shown in Fig 3. The results obtained by calculation were verified from the experimental data. In general, it was established that in the case of moderate contamination of the exploitation zone, its porosity will be equal to that of the external zone with a decrease of the radius of the well. In this case the curve $\phi(\ell n t_0)$ (Fig 3) enters an asymptote, the inclination of which corresponds to the porosity of the external zone. When the curve bends downwards, this indicates a high degree of contamination, i.e. a large encircling zone. Similarly, in the case of a fault, a normal curve (Fig 3) shows its distant position but when the curve bends upwards, this indicates the proximity of a fault. The author expresses gratitude to

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SOV/24-58-7-7/36

The Effect of the Nonuniformity of Oil-Bearing Strata on the Determination of ... Parameters with an Unsteady Flow of Oil to the Well

A. P. Krylov for his criticisms. There are 3 figures and 4 references, of which 3 are Soviet and 1 English.

ASSOCIATION: Institut nefti AN SSSR (Oil Institute, Academy of Sciences, USSR)

SUBMITTED: March 20, 1958.

Card 6/6

BARENBLATT, G.I.

Calculating the distribution of pressure in elastic compression during fluctuating well yield. Trudy Inst.nefti 11:165-169 '58.
(MIRA 11:12)

(Petroleum engineering)

20-118-4-13/61

AUTHORS: Zel'dovich, Ya. B., Corresponding Member AS USSR,
Barenblatt, G. I.

TITLE: Asymptotic Properties of Automodel Solutions of Equations for the Unsteady Motion of Gas Through Porous Media (Ob asimptoticheskikh svoystvakh avtomodel'nykh resheniy uravneniy nestatsionarnoy fil'tratsii gaza)

PERIODICAL: Doklady Akademii Nauk SSSR, 1958, Vol. 118, Nr 4, pp. 671-674 (USSR)

ABSTRACT: At first, a short reference is made to previous papers dealing with the same subject. The authors here investigate the asymptotic behaviour of the solutions of Cauchy's problem for the equations by L. S. Leybenzon for the unsteady filtration of a gas: $\frac{\partial u}{\partial t} = a^2 \frac{\partial^2 u^{n+1}}{\partial x^2}$ or $\frac{\partial w^{1/(n+1)}}{\partial t} = a^2 \frac{\partial^2 w}{\partial x^2}$; $w = u^{n+1}$. Here n denotes the density of the gas, a^2 a constant depending upon the properties of the medium and of the gas, x a coordinate $(-\infty < x < \infty)$, t time, n the exponent of the polytropic line. These solutions correspond to the

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20-118-4-13/61

Asymptotic Properties of Self-Preserving Solutions of Equations for the Unsteady Motion of Gas Through Porous Media

limited initial distributions $u(x,0) = U(x)$, which tend toward zero outside a certain finite interval of the x-axis. For the purpose of illustrating this the linear case ($n = 0$) is investigated. The solution of Cauchy's problem is given for this case and is specialized for great t. In this case, the solution can be represented in the form of a sum of automodel terms, in which the absolute values of the powers of time increase by 1/2 on each step. The coefficients are expressed by the successive moments of the initial distribution. The general solution tends toward the automodel solution $u_0(x,t) = (E/2a\sqrt{\pi t})e^{-x^2/4a^2t}$

Then the authors turn to the nonlinear case ($n = 0$). The solution of the problem investigated here satisfies certain relations given here. The self-preserving solution corresponding to these conditions is written down explicitly and is discussed, and an asymptotic representation is written down in particular. In the solution of the nolinear problem there exists a boundary of the perturbed domain, which characterizes the peculiarities of the solution. In a quite analoguous way the asymptotic character of the automodel

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20-118-4-13/61

Asymptotic Properties of Self-Preserving Solutions of Equations for the Unsteady Motion of Gas Through Porous Media

solutions, is determined, which correspond to various mixed boundary problems. The solutions of the dipole type in particular belong to this class. There are 7 references, all of which are Soviet.

ASSOCIATION: Institut nefti Akademii nauk SSSR (Petroleum Institute, AS USSR)

SUBMITTED: October 12, 1957

AVAILABLE: Library of Congress

Card 3/3

BARENBLAT, G. I., KHRISTIANOVICH, S. A., ZHELTOV, Y. P., and MAKSIMOVICH, G. K.

"Theoretical Principles of Hydraulic Fracturing of Oil Strata."

Report to be submitted at the Fifth World Petroleum Congress, 30 May - 5 June 1959. New York City.

BARENBLATT, G.I. (Moskva)

Equiponderant cracks caused by ruptures of brittle materials. General.concepts and hypotheses. Axisymmetric cracks. Prikl. mat. i mekh. 23 no.3:434-444 My-Je '59. (MIRA 12:5)
(Deformation (Mechanics))

15(6) SOV/20-127-1-12/65

AUTHOR: Barenblatt, G. I.

TITLE: On the Equilibrium Cracks Formed on Brittle Fracture (O ravnovesnykh treshchinakh, obrazuyushchikhsya pri khrupkom razrushenii)

PERIODICAL: Doklady Akademii nauk SSSR, 1959, Vol 127, Nr 1, pp 47-50 (USSR)

ABSTRACT: In brittle materials cracks are formed in the following manner: There is a very large number of microcracks in the material with all kinds of orientations. With an increase of load, a tension is attained at a certain point within the body, which suffices for the widening of the microcrack existing at that point. In the present paper equilibrium cracks are investigated, i.e. cracks, the dimensions of which do not vary with a given load. These cracks may be subdivided according to two ranges: 1) In the internal range, the opposing edges of the crack are divided from each other by a considerable distance, and the interaction between them is negligibly small. 2) In the end-range there is considerable interaction between the banks which are close together. The entire scheme is based upon 3 hypotheses: a) The longitudinal measurements of the end-range are small compared to those of the entire

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crack. b) The distribution of the displacements of the points of the surface of the crack in the section of the end-range with the plane that is perpendicular to the contour of the crack does not depend on the action of the loads, and is always the same for a given material and at given conditions. c) The opposing banks of the crack gradually touch at their ends, or, which comes to the same effect, tension at the ends of the crack is finite. The following is found: The dimensions of the equilibrium crack are uniquely determined by the applied tensions and by a new universal characteristic of the material. The author then investigates an infinite plane plate with rectilinear equilibrium crack under the action of an expanding load which is symmetric with respect to the crack. The state of tension in the plate with the crack is represented as the sum of two states of tension, of which the one corresponds to a plate without a crack, which is drawn apart by the given load, while the other corresponds to a plate with a crack, on the surface of which certain drawing-apart stresses and interlinking forces are applied. The author then deduces an expression for a new universal

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On the Equilibrium Cracks Formed on Brittle Fracture

characteristic of the material, the "interlinking modulus" K. The dimensions of the crack are uniquely determined by the effect produced by the load and by the quantity K. The modulus K is connected with the elastic characteristics of the material and with the surface tension T occurring in the theory of Griffith (Ref 1). Finally, several examples are investigated. There are 2 figures and 9 references, 6 of which are Soviet.

ASSOCIATION: Institut geologii i razrabotki goryuchikh iskopayemykh Akademii nauk SSSR (Institute for the Geology and the Refining of Mineral Fuels of the Academy of Sciences, USSR)

PRESENTED: March 21, 1959, by Ya. B. Zel'dovich, Academician

SUBMITTED: March 13, 1959

Card 3/3

BARENBLATT, G. I., ZEL'DOVICH, Ya. B. (Moscow)

"On the Stability of Selfsimilar and Other Invariant Solutions in the Theory of Wave Propagation."

report presented at the First All-Union Congress on Theoretical and Applied Mechanics, Moscow, 27 Jan - 3 Feb 1960.

BARENBLATT, G. I. (Moscow)

"Some Unsteady Flow Problems Relating to Flows of Homogeneous and Inhomogeneous Fluids Through Porous Media."

report presented at the First All-Union Congress on Theoretical and Applied Mechanics, Moscow, 27 Jan - 3 Feb 1960.

BARENBLATT, G.I.

BARENBLATT, G. I., Institute of Geology and Refining of Mineral Fuels, Academy of Sciences USSR - "Theory and laboratory modeling of fractured reservoir rocks with synthetic porosity" (Section IV)

BOBROV, Ivan V., Makeyevka Scientific Research Institute for Labor Safety in Mining Industries - "Study of gas outburst phenomena" (Section III)

BROD, Ignatiy O., Moscow State University im. M. V. Lomonosov, Head, Chair, Geology and Geochemistry of Combustible Minerals - "Methods of comparative estimation of oil and gas occurrence possibilities" (Section IV)

FEDOROV, Sergey A., Institute of Petroleum, Academy of Sciences USSR - "Soviet results in the field of shaft sinking" (Section III)

KASIMOV, A. F., Azerbaydzhan Polytechnic Institute - "Theoretical bases of sand flow into the wells and their application for oil production" (Section IV)

OSTROUSHKO, Ivan A., North Caucasus Institute of Mining and Metallurgy - "Methods of increasing the rate of boring holes for exploration and exploitation in hard rocks" (Section II)

PETUKHOV, I. M., Leningrad Mining Institute - "Utilization of rock pressure and the macrostructure of coal seams to facilitate mining" (Section I)

POPOV, G. N., Moscow Institute of Nonferrous Metals and Gold im. M. I. Kalinin - "Technical results obtained in the Soviet Union at the exploitation of bauxite deposits" (Section II)

TIKHONOV, N. V., Moscow Geological Prospecting Institute im. S. Ordzhonikidze - "Full mechanization of the driving of mine roadways and prospecting drifts in the Soviet Union" (Section I)

ZAPADINSKIY, Aron P. - "Determination of the variation of stresses originating in wall rock masses" (Section I)

REPORTS TO BE SUBMITTED FOR THE MINING CONGRESS, MINING AND METALLURGICAL SOCIETY, Budapest, Hungary, 12-18 Sep 19[illegible]

BARENBLATT, G.I.

Using pressure build-up curves for determining the parameters of a petroliferous layer. Trudy Inst. geol. i razrab. gor. iskop. 2:153-158 '60. (MIRA 14:5)
(Oil reservoir engineering)

24.4000

S/179/60/000/03/013/039
E191/E481

AUTHORS: Barenblatt, G.I. and Cherepanov, G.P. (Moscow)

TITLE: About the Effect of the Boundaries of a Body on the Propagation of Cracks in Brittle Failure 16

PERIODICAL: Izvestiya Akademii nauk SSSR, Otdeleniye tekhnicheskikh nauk, Mekhanika i mashinostroyeniye, 1960, Nr 3, pp 79-88 (USSR)

ABSTRACT: The propagation of cracks at the boundaries of a body possesses certain specific features. Contrary to the propagation of isolated cracks in an infinite medium, in the case of proximity to a boundary an instability invariably arises when the load reaches a critical value. The instability is associated with the instantaneous emergence of the crack at the surface of the body. The problem arises of finding these critical loads. Typical cases of cracks in finite bodies are considered using the solution obtained by a method of successive approximations developed in the papers of S.G.Mikhlin (Ref 1) and D.I.Sherman (Ref 2). At first, an arbitrary system of cracks located along a straight line in an infinite body is considered as a subsidiary problem. The infinite body is subject to a tension load. The case

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E191/E481

About the Effect of the Boundaries of a Body on the Propagation of Cracks in Brittle Failure

of a system of cracks symmetrically disposed in relation to an axis normal to the straight line is assumed. A symmetrical load system acting on the internal crack surfaces represents the normal load. A crack near a boundary, when its dimensions are small, can be considered as being near the face of a semi-infinite body. The first approximation consists of identifying the face with the axis of symmetry in the subsidiary problem just defined. Although this approximation does not satisfy the condition of zero stress at the free face, it is shown that for the purposes of the main problem this discrepancy is immaterial. The critical values of the force in the case of a crack at a given depth from the boundary of the body with two concentrated forces applied to opposing points of the crack surface is found to be proportional to the square root of the given depth. Until the critical load is reached, the crack develops without reaching the surface. A crack at right angles to the edges of an infinite

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S/179/60/000/03/013/039
E191/E481

About the Effect of the Boundaries of a Body on the Propagation of Cracks in Brittle Failure

strip is examined when the crack is symmetrical in relation to the strip centre line. There is a critical value of the load configuration below which a stable equilibrium exists in a cracked strip. In an example of a load system consisting of two forces separated by a certain distance and symmetrical about the strip centre line, there is a critical distance below which such an equilibrium exists. This is shown to be about two/thirds of the width of the strip. It is shown that the first approximation used in the present paper is of sufficient accuracy. The second approximation in a typical problem introduces a correction of only 2.5% There are 9 figures and 9 references 8 of which are Soviet and 1 English.

SUBMITTED: December 31, 1959

Card 3/3

16.7300

80252
S/040/60/024/02/16/032

AUTHOR: Barenblatt, G. I. (Moscow)

TITLE: On Finiteness Conditions in the Mechanics of Continua. Static Problems of the Theory of Elasticity

PERIODICAL: Prikladnaya matematika i mekhanika, 1960, Vol. 24, No. [illegible], pp. 316-322

TEXT: The solution of an elastic boundary value problem is assumed to be not uniquely determined. Let the set of the undetermined elements of the solution be M, and the set of the undetermined elements varies in an admissible way $M + \delta M$. Let u be the displacement field of the considered elastic system which corresponds to a fixed M; let $\delta_1 u$ be the variation of the field which is compatible with the geometric assumptions and which corresponds to the same M; $\delta_2 u$ is assumed to be the variation which corresponds to δM. The state which is characterized by the field $u + \delta_1 u + \delta_2 u$ is a possible state of the system. The principle of virtual displacements gives

(1.1) $$\delta W - \delta A = 0$$

where δW is the variation of the elastic potential W and δA the variation of the work of the external forces. More explicitly written

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80252
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On [illegible] Conditions in the Mechanics of Continua. Static Problems of the Theory of Elasticity

(1.1) gives the relation

(1.2) $\delta_1 W - \delta_1 A + \delta_2 W - \delta_2 A = 0$

[illegible] $\delta_1 W$ and $\delta_1 A$ correspond to the variation $\delta_1 u$ for fixed M and $\delta_2 W$, $\delta_2 A$ correspond to the variation δM. From (1.2) there follow (Ref 1) the differential equations and boundary conditions of the problem with the set M of undetermined elements. According to Clapeyron, however, it is

(1.3) $2W = A$ for every M.

[illegible] it follows

(1.4) $2\delta_2 W = \delta_2 A$

[illegible] from (1.4) it finally follows

(1.5) $\delta_2 W = 0$.

[illegible] is a general condition for the determination of the set of the undetermined elements; [illegible] set of all M appears in [illegible]

Card 2/[illegible]

80252
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On Finiteness Conditions in the Mechanics of Continua. Static Problems of the Theory of Elasticity

[illegible] which the elastic potential possesses an extremum. If the solution particularly depends only on the undetermined [illegible] [illegible], then they are to be determined from

$$\frac{\partial W}{\partial c_j} = 0 \quad (j = 1, \ldots, n) \qquad (1.8)$$

Then the author shows that the conditions for the finiteness of the tension can be concluded from (1.7). As examples the author treats the contact probelm and the problem of the crack.

[illegible] Khristianovich, P. A. Rebinder and L. [illegible] are mentioned in the paper. The author thanks Ya. B. Zel'dovich for discussions.

There are 1 figure, and 5 references: 3 Soviet, 1 American and 1 English.

SUBMITTED: November 17, 1959

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APPROVED FOR RELEASE: 06/08/2000 CIA-RDP86-00513R000203610017-1"

BARENBLATT, G. I. (Moskva); CHEREPANOV, G.P. (Moskva)

Destruction of the wedge shape of brittle bodies. Prikl. mat. i mekh. 24 no.4:667-682 Jl-Ag '60. (MIRA 13:9)
(Aerodynamics)

BARENBLATT, G.I. (Moskva); ZHELTOV, Yu. P. (Moskva); KOCHINA, I. N. (Moskva)

Basic concepts in the theory of the flow of uniform fluids through fractured rocks. Prikl. mat. i mekh. 24 no.5:852-864 S - 0 '60. (MIRA 14:3)

(Oil reservoir engineering)

BARENBLATT, G.I.

Regarding V.S.Vladislavlev's "Modeling the performance of a bit on a well bottom." Neft. khoz. 38 no.11:39-40 N '60.
(MIRA 14:4)

(Boring machinery) (Engineering models)
(Vladislavlev, V.S.)

S/207/61/000/004/001/012
E081/E514

AUTHOR: Barenblatt, G.I. (Moscow)

TITLE: Mathematical theory of equilibrium cracks formed during brittle rupture

PERIODICAL: Akademii nauk SSSR. Siberskoye otdeleniye. Zhurnal prikladnoy mekhaniki i tekhnicheskoy fiziki, no.4, 1961, 3-56

TEXT: This is a review of the subject and includes a comprehensive bibliography. The subject matter is given under the following headings: I - Introduction; II - Sketch of the development of the theory of equilibrium cracks; III - Structure of the boundary of an equilibrium crack in a brittle body; IV - Basic hypotheses and general formulation of equilibrium-crack problems (cohesive forces, terminal and internal regions, basic hypotheses, cohesive modulus, boundary conditions on the contour of an equilibrium crack, basic problems in the theory of equilibrium cracks, energy derivation of the boundary conditions on the contour of an equilibrium crack, experimental confirmation of the theory of brittle rupture, quasi-brittle rupture, cracks

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in thin plates), V - Specific problems in the theory of equilibrium cracks (isolated rectilinear cracks, plane axially symmetric cracks, studies of the development of isolated cracks during proportional loading, stability of isolated cracks, cracks issuing from the surface of a body, cracks near the surface of a body, systems of cracks); VI - Splitting. Dynamic problems in the theory of cracks (splitting of an infinite body, splitting of a strip, dynamic problems in the theory of cracks). Acknowledgments are expressed to Ya. B. Zel'dovich and Yu. N. Rabotnov (AS USSR) for their interest and advice. The assistance given by Professor G. G. Chernyy (MGU) and I. A. Markuzon (who compiled the bibliography) is acknowledged. There are 36 figures, 1 table and 111 references: 44 Soviet-bloc and 67 non-Soviet-bloc. The four latest English-language references read as follows: Ref.105: Baker, B.R. Dynamic stresses created by a moving crack. Paper presented at the 10th Intern.Congr.Appl.Mech.Stresa,1960; Ref.107:Broberg, K.B. The propagation of a brittle crack. Ibid; Ref.109: Bilby B.A. and Bullough R. The formation of twins by a moving crack. Phil.mag. 1954, VII, ser.45,631-646; Ref.110:McClintock F.A.,Sukhatme S.P. Travelling cracks in elastic materials ... J.Mech.Phys.Solids,1960,8,187-193.

SUBMITTED: April 28,1961

89387

10.9200

16.7300

S/040/61/025/001/006/022
B125/B204

AUTHORS: Barenblatt, G. I., Cherepanov, G. P. (Moscow)

TITLE: The equilibrium and propagation of cracks in an anisotropic medium

PERIODICAL: Prikladnaya matematika i mekhanika, v. 25, no. 1, 1961, 46-55

TEXT: On the basis of the ideas developed by the authors in two earlier papers (Refs. 1, 2), several problems concerning the equilibrium and the propagation of straight cracks in an anisotropic medium are investigated. In this plane deformation of an elastic anisotropic medium, the generalizing Hooke law is assumed: $\sigma_{ij} = b_{ij\beta\gamma}\varepsilon_{\beta\gamma}$ $\left(\varepsilon_{ij} = \frac{1}{2}\left[\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i}\right]\right)$. (1.2). The equations of motions read $\frac{\partial \sigma_{i\alpha}}{\partial x_\alpha} = \rho\frac{\partial^2 u_i}{\partial t^2}$ $(i = 1,2)$ (1.1). From (1.1) and (1.2) the dynamic principal equations: $L_{i\alpha}u_\alpha = 0$, $L_{ij} = \frac{1}{2}(b_{i\alpha\beta j} + b_{i\alpha j\beta})\frac{\partial^2}{\partial x_\alpha \partial x_\beta} - \rho\frac{\partial^2}{\partial t^2}\delta_{ij}$ result

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The equilibrium and propagation...

(1.3), where δ_{ij} is the Kronecker symbol. The general solution of (1.3) is $u_1 = L_{22}\Psi_2 - L_{12}\Psi_1$, $u_2 = L_{11}\Psi_1 - L_{12}\Psi_2$ (1.4) with $(L_{11}L_{22} - L_{12}^2)\Psi' = 0$ (1.5). The authors here investigate various variants of the mixed problem of the elasticity theory for an anisotropic semiplane, which is at rest in the system of coordinates ξ_1, ξ_2, which moves with the constant velocity v in the direction of the negative x_1-axis. In the steady case there follows from (1.5) $B_{\alpha\beta\gamma\varepsilon}\frac{\partial^4\psi}{\partial\xi_\alpha\partial\xi_\beta\partial\xi_\gamma\partial\xi_\varepsilon} = 0$, $B_{\alpha\beta\gamma\varepsilon} = A_{11\alpha\beta}A_{22\gamma\varepsilon} - A_{12\alpha\beta}A_{12\gamma\varepsilon}$ (1.8). In addition hereto there is the characteristic equation $B_{\alpha\beta\gamma\varepsilon}\mu^{\delta_{\alpha 1}+\delta_{\beta 1}+\delta_{\gamma 1}+\delta_{\varepsilon 1}}$ (1.9). Furthermore, the elliptic case is investigated, which, according to S. G. Lekhnitskiy, is always given in the static problem. According to L. A. Galin, the general solution of (1.8) is written down in the form $\Psi = 2\mathrm{Re}[F_1(z_1) + F_2(z_2)]$,

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The equilibrium and propagation...

$z = \xi_1 + \mu_i \xi_2$ (1.11), where F_1 and F_2 are arbitrary analytical functions and μ_1, μ_2, $\bar{\mu}_1$, $\bar{\mu}_2$ are the roots of the characteristic equation. Herefrom it follows for the displacements u_i and the stresses σ_{ij}

$u_i = 2\mathrm{Re}\left[d_{i\alpha}\varphi_\alpha(Z_\alpha)\right]$, $\sigma_{ij} = 2\mathrm{Re}\left[e_{ij\alpha}\varphi'_\alpha(Z_\alpha)\right]$ $(\varphi_j(Z_j) = F''_j(Z_j))$ (1.12).

Further, (1.13) holds.

$$d_{1j} = -b_{1112} - (b_{1122} + b_{1212})\mu_j - b_{1222}\mu_j^2 \qquad (1.13)$$

$$d_{2j} = b_{1111} - \rho v^2 + 2b_{1112}\mu_j + b_{1212}\mu_j^2$$

$$e_{11j} = \mu_j(b_{1112}^2 - b_{1111}b_{1212}) + \mu_j^2(b_{1112}b_{1122} - b_{1111}b_{1222}) + \\ + \mu_j^3(b_{1122}b_{1212} - b_{1112}b_{1222}) - \rho v^2(b_{1112} + \mu_j b_{1122})$$

$$e_{12j} = (b_{1111}b_{1212} - b_{1112}^2) - \rho v^2(b_{1212} + \mu_j b_{2122}) + \\ + \mu_j[b_{1111}b_{2122} - b_{1122}b_{1112} + \mu_j(b_{1112}b_{2122} - b_{1212}b_{1122})]$$

$$e_{22j} = (b_{2122}b_{1111} - b_{1112}b_{1122}) + \mu_j[b_{2122}b_{1112} - b_{1122}(b_{1122} + b_{1212}) + \\ + b_{1111}b_{2222} + 2\mu_j b_{2222}b_{1112} + \mu_j^2(b_{1212}b_{2222} - b_{2122}^2)] - \rho v^2(b_{2122} + \mu_j b_{2222})$$

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The equilibrium and propagation...

In part 2, the general problem for the semiplane, the Rayleigh surface waves, and a moving stamp are investigated. For this purpose, the analytical functions $\omega_1(z) = \int_{-\infty}^{\infty} \frac{\sigma(\xi)d\xi}{\xi - z} = U_1 - iV_1$, $\omega_2(z) = \int_{-\infty}^{\infty} \frac{\tau(\xi)d\xi}{\xi - z} = U_2 - iV_2$ (2.1) according to L. A. Galin, are introduced. $\sigma(\xi_1)$ and $\tau(\xi_1)$ denote the distributions of the normal stresses and tangential stresses on the boundary. With

$$\left(\frac{\partial u_1}{\partial \xi_1}\right)_{\xi_2=0} = \mathrm{Re}\left[\frac{d_{12}e_{121} - d_{11}e_{122}}{2\pi i\Delta} w_1(\xi_1) + \frac{d_{11}e_{222} - d_{12}e_{221}}{2\pi i\Delta} w_2(\xi_1)\right] \quad (2.5)$$

$$\left(\frac{\partial u_2}{\partial \xi_1}\right)_{\xi_2=0} = \mathrm{Re}\left[\frac{d_{22}e_{121} - d_{21}e_{122}}{2\pi i\Delta} w_1(\xi_1) + \frac{d_{21}e_{222} - d_{22}e_{221}}{2\pi i\Delta} w_2(\xi_1)\right] \quad (2.6)$$

and

$$w_1(\xi_1) = \text{v. p.} \int_{-\infty}^{\infty} \frac{\sigma(\zeta)\,d\zeta}{\zeta - \xi_1} - i\pi\sigma(\xi_1), \quad w_2(\xi_1) = \text{v. p.} \int_{-\infty}^{\infty} \frac{\tau(\zeta)\,d\zeta}{\zeta - \xi_1} - i\pi\tau(\xi_1) \quad (2.7)$$

the steady mixed problem of the dynamic elasticity theory for the anisotropic semiplane can be reduced to the well investigated problem of the Hilbert theory of analytical functions. (See the monographs by

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The equilibrium and propagation...

N. I. Muskhelishvili and F. D. Gakhov). First, surface waves on the boundary of an anisotropic semiplane are investigated. For their propagation velocity one finds

$$PR - PS\frac{M}{L} + (PS + QR)\sqrt{\frac{N}{L}} - QS\frac{N}{L} = 0 \qquad (2.12)$$

$$P = b_{1111} - \rho v^2, \qquad Q = b_{1122}$$
$$R = b_{2222}(b_{1111} - \rho v^2) - b_{2211}(b_{1212} + b_{1122})$$
$$S = b_{1212}b_{2222}$$

For a stamp moving on the boundary $\xi_2 = 0$ of the anisotropic elastic semiplane with existing Coulomb friction upon the contact surface between stamp and body the boundary conditions read $\sigma_{12} = \sigma_{22} = 0$, $(-\infty < \xi_1 < a,\ b < \xi_1 < \infty)$, $\sigma_{12} = k\sigma_{22}$, $\frac{\partial u_2}{\partial \xi_1} = f'(\xi_1)$, $\int_a^b \sigma_{22}(\xi)d\xi = P$, $a \leqslant \xi_1 \leqslant b$ (2.14). With the stamp velocity approaching the velocity of the surface waves, peculiar resonance phenomena occur with these waves.

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The equilibrium and propagation...

At Rayleigh-type velocities, the motion radically changes. In part 3, an isolated straight-lined crack in an orthotropic body with plane deformation along a line of elastic symmetry is then dealt with. According to Keldysh-Sedov, $\omega_1(z) = -\frac{1}{\sqrt{(z-a)(z-b)}}\int_a^b \frac{\sqrt{(t-a)(t-b)}g(t)dt}{t-z}$ (3.3) holds. For all equilibrium cracks, it holds for the ultimate strength near the end of the cracks that $\sigma_{22} = \frac{K}{\pi\sqrt{s}}$, $(K = \int_0^d \frac{G(t)dt}{\sqrt{t}})$. Here s denotes the distance from the end of the crack, K - the interlinking modulus, G(t) - the distribution of the forces of molecular interlinking within the terminal region of the crack, d - the longitudinal extent of the terminal region. Part 4 then deals with the splitting of the anisotropic body by a thin, absolutely rigid wedge. In front of the wedge, a free crack is formed. The boundary conditions of the corresponding mixed problem are

$$u_2 = 0, \quad \sigma_{12} = 0 \quad (-\infty < \xi_1 \leqslant 0)$$

$$\sigma_{12} = \sigma_{22} = 0 \quad (0 < \xi_1 < l_2) \qquad (4.1)$$

$$\sigma_{12} = k\sigma_{22}, \quad u_2 = -f(\xi_1 - l_1) \quad (l_2 \leqslant \xi_1 < \infty)$$

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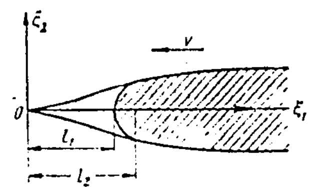
The equilibrium and propagation...

Here, k is the coefficient of Coulomb friction, f(t) - a function describing the wedge-like shape, l_1 and l_2 may be seen from the figure. Especially, the splitting of an orthotropic body by a wedge of constant thickness is investigated. For the length of the free crack in front of the wedge, one finds $l = p^2h^2/K^2 = h^2/\pi^2C_0^2K^2$. For C_0, $C_0 = \frac{\varepsilon_1+\varepsilon_2}{2}\frac{\sqrt{b_{1111}b_{2222}}}{b_{1111}b_{2222}-b_{1122}^2}$ (4.5) holds. With an approach of the velocity of motion to the Rayleigh velocity, the length of the free part of the crack tends towards zero, and the propagation velocity of the crack cannot be greater than the Rayleigh velocity. L. A. Galin and Ye. Ioffe are mentioned. There are 1 figure and 14 references: 11 Soviet-bloc and 3 non-Soviet-bloc.

SUBMITTED: July 25, 1960



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S/040/61/025/006/014/021
D299/D304

10.7400 3201,3504

AUTHORS: Barenblatt, G.I., and Cherepanov, G.P. (Moscow)

TITLE: On brittle cracks under longitudinal shear

PERIODICAL: Prikladnaya matematika i mekhanika, v. 25, no. 6, 1961, 1110 - 1119

TEXT: The general relations are set up. Some particular statical and dynamical problems are discussed. It is assumed that the field of elastic displacements is governed by the equations

$$u,\ v \equiv 0,\ w = w(x, y, t), \qquad (1.1)$$

where u, v, w are the components of the vector of elastic displacement. To formula (1.1) corresponds the case of so-called "anti-plane" deformation. The stresses and displacements are expressed by means of the analytic function

$$f(z) = \sum_{k=1}^{n} \frac{F_k + i\mu B_k}{2\pi\mu} \ln(z - a_k) + \varphi(z), \quad \sum_{k=0}^{n} F_k = 0 \qquad (1.6)$$

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where F_k is the resultant force applied to the contour c_k, B_k - the intensity of the "screw dislocation" corresponding to c_k, φ - a univalent analytic function, a_k - an interior point of the contour. In the following, the case $B_k = B = 0$ will be mainly considered. Let an infinite body undergo anti-plane deformations and the constant tangential $\tau_\infty = \tau_\infty e^{i\theta}$ at infinity. The body contains a finite cut of arbitrary shape whose surface is free. In this case,

$$f(z) = \frac{1}{\mu}\tau_\infty e^{-i\theta} g(z) + \frac{\tau_\infty e^{i\theta} R^2}{\mu g(z)} \qquad (2.1)$$

where $g(z)$ is a function which maps conformally the exterior of the contour in the z-plane, onto the exterior of the circle of radius R. As an exemple, a cut with one, respectively two, cracks is considered (see Fig. 1). The mapping function is expressed for these 2 cases by

$$g(z) = \frac{1}{2}Z - \frac{L-r}{2} + \sqrt{\left[\frac{1}{2}Z - \frac{L-r}{2}\right]^2 - \frac{(L+r)^2}{4}} \qquad (2.2)$$

and
$$g(z) = \frac{1}{2} Z + \sqrt{\frac{1}{4} Z^2 - L^2} \tag{2.3}$$

respectively, where
$$Z = z + \frac{r^2}{z}, \qquad L = \frac{1}{2}\left(r + l + \frac{r^2}{r+l}\right) \tag{2.4}$$

The conditions which determine the length l of the crack, are
$$[(1+\lambda)^4 - 1](1+\lambda)^{-5/4}(2+\lambda)^{-1/4}\lambda^{-1/4} = \frac{M}{\pi\tau_\infty \sqrt{r}} \quad \left(\lambda = \frac{l}{r}\right) \tag{2.5}$$
$$\frac{1}{\sqrt{2}}\sqrt{(1+\lambda)[1-(1+\lambda)^{-3}]} = \frac{M}{\pi\tau_\infty \sqrt{r}} \tag{2.6}$$

with $\lambda \longrightarrow \infty$, one obtains
$$l = \frac{M^2}{\pi^2 \tau_\infty^2}, \qquad l = \frac{2M^2}{\pi^2 \tau_\infty^2} \tag{2.7}$$

(M is a constant of the material). As an example of a mixed problem, an isolated rectilinear crack is considered ($-l \leqslant x \leqslant l$), part of

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On brittle cracks under ...

whose surface undergoes the constant displacement $w = \pm h$, whereas the rest of the surface is free. Formulas for the mapping function and the length ℓ are obtained. Interaction between cracks under longitudinal shear: First, the case is considered of an infinite body which undergoes (at infinity) the homogeneous shear stress $\tau_{yz} = \tau_{yz}^{\infty}$, and has an infinite system of similar cracks (see Fig. 4a). In this case,

$$\ell = \frac{2L}{\pi} \text{ arc tg } \frac{M^2}{\pi \tau_{\infty}^{2} L} . \qquad (3.3)$$

Further, a vertical row of cracks is considered (Fig. 4b). Another figure shows the curves

$$\frac{\tau_{\infty}}{\tau^{*}} = f\left(\frac{l}{L}\right) \qquad \left(\tau^{*} = \frac{M}{\sqrt{\pi L}}\right)$$

The interaction between cracks varies considerably with crack disposition. Thus, collinear cracks reduce the strength of the materi-

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al, whereas parallel cracks strengthen it. Curvilinear cracks: With small r, the stress $\tau_{z\theta}$ is expressed by

$$\tau_{z\theta} = \frac{A_1 \cos(\theta/2)}{\sqrt{r}} + A_2 \sin\theta + O(r^{3/2}) \qquad (4.1)$$

where A_1 and A_2 are the coefficients of the expansion terms of f(z). The following hypothesis is adopted: Curvilinear cracks develop in the direction in which $\tau_{z\theta}$ is maximal. Two examples are considered. In fact, only curvilinear cracks which are either almost-linear, can be adequately described by formulas. Dynamical problem of fracture of body. Assume a rectilinear crack travels (with constant velocity V) in an infinite, brittle body. A moving system of coordinates $\xi = x + Vt$, $\eta = y$, is introduced. Thereupon, the equations of motion are

$$\frac{\partial^2 w}{\partial \eta^2} + \left(1 - \frac{V^2}{c^2}\right)\frac{\partial^2 w}{\partial \xi^2} = 0. \qquad (5.1)$$

The solution is

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$$w = \operatorname{Re}\varphi(\zeta), \quad \zeta = \xi + i\eta\sqrt{1 - \frac{V^2}{c^2}} \tag{5.2}$$

where φ is an analytic function; after determining this function, the formulas for the stress are derived. Thereupon, the formula for the free length l of the crack is

$$h - \int_l^\infty f'(t)\sqrt{\frac{t-l}{t}}\,dt = \frac{M\sqrt{l}}{\mu\sqrt{1 - V^2/c^2}} \tag{5.8}$$

where h is the limit value of the function f which represents displacement-distribution. If $f(\xi) \equiv h$, then

$$l = \frac{\mu^2 h^2}{M^2}\left(1 - \frac{V^2}{c^2}\right). \tag{5.9}$$

From (5.9) it is evident that for cracks under longitudinal shear, the limit velocity of propagation is the velocity of sound c, whereas for cracks under transverse shear, the limit velocity is that

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On brittle cracks under ...

of Rayleigh waves. There are 9 figures and 14 references: 8 Soviet-bloc and 6 non-Soviet-bloc. The 4 most recent references to the English-language publications read as follows: F.A. McClintock and S.P. Sukhatme, Traveling cracks in elastic materials under longitudinal shear, J. Mech. and Phys. of Solids, 1960, v. 8, 187 - 193; O.L. Bowie, Analysis of an infinite plate containing radial cracks originating at the boundary of an internal circular hole, J.Math. and Phys., 1956, v. 25; F.C. Roesler, Brittle fracture near equilibrium, Proc. Phys. Soc., 1956, v. B. 69; J.J. Benbow, Cone cracks in fused silica, Proc. Phys. Soc., 1960, v. B. 75, 697 - 699.

X

ASSOCIATION: Institut mekhaniki Moskovskogo gosudarstvennogo universiteta (Institute of Mechanics, Moscow State University)

SUBMITTED: July 26, 1961

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S/020/61/140/006/009/030
B104/B102

AUTHORS: Zel'dovich, Ya. B., Academician, Barenblatt, G. I., and Salganik, R. L.

TITLE: Quasi-periodic precipitations during mutual diffusion of two substances (Lisegang rings)

PERIODICAL: Akademiya nauk SSSR. Doklady, v. 140, no. 6, 1961, 1281 - 1284

TEXT: During mutual diffusion of two reacting substances insoluble precipitates fall out in so-called Lisegang rings. The most probable formation of Lisegang rings is described as follows: During diffusion the solution is supersaturated as long as the product ab of the concentrations a and b of the substances A and B does not reach a critical value k (metastable limit). As ab exceeds k at a given point, one of the reaction components is precipitated completely. Due to diffusion, a new portion of this component enters the impoverished region and the precipitation mechanism appears again. If the region of precipitations does not propagate too fast, the following precipitation is somewhat distant from the pre-

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vious one. In the present paper, an approximation of the formation of Lisegang rings during diffusion of substances in a cylindrical tube is given. The authors derive a and b as functions of the reduced parameter $\xi = x/x_n$, where x is the coordinate of the axis of the tube, and x_n is the coordinate of the n-th precipitation. For sufficiently high n the distributions of a and b within the ranges $1 < \xi < \alpha$ and $1 < \tau < \gamma$ ($\tau = t/t_n$) depend on $c = a_0/b_0$ (a_0 and b_0 are the concentrations before diffusion starts), $\varkappa = k/a_0 b_0$ and $\alpha^2 = D_a/D_b$ (D_a and D_b are the diffusion coefficients of the substances A and B). The distributions do not depend on n. Under this condition of quasi-periodicity the distributions of a and b as functions of $\mu = x_{n+1}/x_n$, $\gamma = t_{n+1}/t_n$, $\eta = \sqrt{D_a t_{n+1}}/x_{n+1}$, μ, c and $\varkappa$ are studied. The results allow the metastable limit k to be experimentally determined. The authors thank L. Ya. Semenova for calculations. There are 2 figures and 3 Soviet references.

ASSOCIATION: Institut mekhaniki Moskovskogo gosudarstvennogo universiteta im. M. V. Lomonosova (Institute of Mechanics of Moscow State University imeni M. V. Lomonosov)

Card 2/3

S/020/61/140/006/009/030
B104/B102

Quasi-periodic precipitations during ...

SUBMITTED: July 25, 1961

Card 3/3

BARENBLATT, G.I. (Moskva); CHEREPANOV, G.P. (Moskva)

Comments on the article "Effect of the boundaries of a body on the development of brittle-breakdown cracks", published in "Izvestiia AN SSSR, OTN, Mekhanika i mashinostroenie," no.3, 1961. Izv.AN SSSR.Otd.tekh.nauk.Mekh.i mashinostr no.1:153 Ja-F '62. (MIRA 15:3)

(Strength of materials)

BARENBLATT, G.I. (Moskva); ZEL'DOVICH, Ya.B. (Moskva); ISTRATOV, A.G. (Moskva)

Diffusion heat stability of a laminar flame. PMTF no.4:21-26 Jl-Ag '62. (MIRA 16:1)

(Flame)

S/040/62/026/002/015/025
D299/D301

AUTHORS: Barenblatt, G.I., Salganik, R.L., and Cherepanov, G.P. (Moscow)

TITLE: On the propagation of running cracks

PERIODICAL: Prikladnaya matematika i mekhanika, v. 26, no. 2, 1962, 328 - 334

TEXT: A formula is derived for the rate of propagation of the crack as a function of the applied stress. This formula is discussed as well as the experiments by A.A. Wells and D. Post. An infinite, homogeneous, isotropic, brittle, and elastic body is considered, under a constant stress p. The length $2l_0$ of the initial crack exceeds the critical value, so that the crack starts developing at once. The assumptions are stated with respect to the 2 regions (internal and terminal) into which the crack surface is divided; the distribution of the cohesion forces g(x) is also given. These forces are taken into account in the derivation of the formula for the rate of propagation of the crack as a function of p. After transformations, one obtains the desired formula

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On the propagation of running cracks S/040/62/026/002/015/025 D299/D301

$$\frac{p\sqrt{\nu/c}}{R} = \frac{1}{F(m, \nu)}, \qquad (2.8)$$

where c, ν and R are material constants, and m = V/c (V being the rate of propagation). Formula (2.8) is plotted for several values of ν. With sufficiently small p, Eq. (2.8) has no solution, so that no uniform-propagation regime exists. With p, larger than the critical value, corresponding to the minimum of the right-hand side of (2.8), there are for each value of p, 2 values of m; to the smaller of the two values corresponds non-stationary crack propagation, whereas to the larger value corresponds uniform propagation. The latter can only occur in the time interval

$$l_0/c < t < T \qquad (3.4)$$

where T is the time in which the terminal region develops. With t > T, the cohesion forces can no longer sustain uniform propagation; the rate of propagation increases until it reaches a value at which the crack ramifies; thereupon linear propagation ceases. The above theoretical considerations are in agreement with the experiments by Wells and Post. The quantity R is determined by means of
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On the propagation of running cracks S/040/62/026/002/015/025
D299/D301

their experimental data. There are 5 figures and 9 references: 3 Soviet-bloc and 6 non-Soviet-bloc. The 4 most recent references to the English-language publications read as follows: K.B. Broberg, The propagation of a brittle crack, Arkiv för fysik, 1960, v. 18, 159-192; A.A. Wells and D. Post, The dynamic stress distribution surrounding a running crack, -a photoelastic analysis. Proc. Soc. Exper. Stress Analysis, 1958, v. 16, no. 1; G.R. Irwin. The dynamic stress distribution surrounding a running crack, -a photoelastic analysis. Discussion. Proc. Soc. Exper. Stress Analysis, 1958, v. 16, no. 1; G.R. Irwin, Fracture, in "Encyclopedia of Physics", v. 6, 551-590, Springer-Verlag, Berlin, 1958.

ASSOCIATION: Institut mekhaniki Moskovskogo universiteta (Institute of Mechanics of Moscow University)

SUBMITTED: November 30, 1961

Card 3/3

38028

24 4200
17

S/040/62/026/003/011/020
D407/D301

AUTHORS: Barenblatt, G.I., and Ishlinskiy, A.Yu. (Moscow)

TITLE: On the impact between a viscous-plastic bar and a rigid obstacle

PERIODICAL: Prikladnaya matematika i mekhanika, v. 26, no. 3, 1962, 497 - 502

TEXT: The impact problem is formulated and an effective approximate solution is obtained. A bar of finite length, made of incompressible viscous-plastic material, moves along its axis and hits at the moment $t = 0$ a rigid obstacle. It is assumed that the stresses, velocities, etc. are averaged over the bar-section. The relation between the mean stress σ and the strain-rate $\partial v/\partial x$, is

$$\frac{\partial v}{\partial x} = \begin{cases} \dfrac{\sigma + \sigma_0}{\mu} & (|\sigma| \geq \sigma_0) \\ 0 & (|\sigma| \leq \sigma_0) \end{cases} \qquad (1.1)$$

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where σ_0 is the critical stress and μ is the viscosity coefficient. At $t > 0$, the pattern of motion is as follows: The elastic disturbances travel instantaneously through the entire bar which is divided into 2 regions: the viscous-plastic region, where the critical stress is exceeded and viscous-plastic flow occurs, and the rigid region, where the critical stress is not exceeded and the bar moves like a rigid body. At the moving boundary between these two regions which has to be determined in the solution of the problem, the stresses and velocities are continuous. The velocity satisfies, in the viscous-plastic region, the heat-conductivity equation

$$\frac{\partial v}{\partial t} = a^2 \frac{\partial^2 v}{\partial x^2}, \quad a^2 = \frac{\mu}{\rho} \ (0 \leqslant x < x_0(t)). \qquad (1.3)$$

The equation of motion of the rigid region reduces to

$$\frac{dv_0(t)}{dt} = - \frac{\sigma_0}{\rho[1 - x_0(t)]}. \qquad (1.7)$$

The initial and boundary conditions are also set up. Thus, the prob-

On the impact between a viscous ... S/040/62/026/003/011/020
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lem amounts to determining the functions $v(x, t)$, $v_0(\tau)$ and $x_0(t)$, satisfying the above equations, i.e. to the problem of the moving boundary for the heat-conductivity equation, which does not lead to a well-known boundary-value problem. Dimensionless variables are introduced

$$u(\xi, \tau) = -\frac{v(x, t)}{v_0}, \quad \xi = \frac{x}{l}, \quad \xi_0(\tau) = \frac{x_0(t)}{l}, \quad \tau = \frac{a^2 t}{l^2}, \quad u_0(\tau) = \frac{v_0(t)}{v_0}. \tag{2.1}$$

Eqs. (1.5), (1.7) and the boundary conditions are used for obtaining the system

$$\frac{\partial u}{\partial \tau} = \frac{\partial^2 u}{\partial \xi^2} \qquad (0 \leqslant \xi \leqslant \xi_0(\tau)) \tag{2.2}$$

$$\frac{du_0(\tau)}{d\tau} = -\frac{s}{1 - \xi_0(\tau)} \tag{2.3}$$

$$u[\xi_0(\tau), \tau] = u_0(\tau), \qquad \frac{\partial}{\partial \xi} u[\xi_0(\tau), \tau] = 0, \qquad u(0, \tau) = 0 \quad (\tau > 0) \tag{2.4}$$

where s is Saint-Venant's parameter. An approximate solution to system (2.2) - (2.4) is obtained on the basis of von-Karman-Pohlhausen's method of boundary-layer theory. Thereby the function $u(\xi, \tau)$ is approximated by the formula

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$$u(\xi, \tau) = \begin{cases} 2u_0(\tau)\dfrac{\xi}{\xi_0(\tau)} - u_0(\tau)\dfrac{\xi^2}{\xi_0^2(\tau)} & (0 \leqslant \xi \leqslant \xi_0(\tau)); \\ u_0(\tau) & (\xi_0(\tau) \leqslant \xi \leqslant 1) \end{cases} \qquad (3.1)$$

It is required that the function (3.1) satisfy Eq. (2.2) in the mean i.e. an integral formula, obtained from (2.2). From this formula, in conjunction with (2.3), it is possible to obtain the approximate solution. New variables are introduced:

$$p = \frac{u_0(\tau)}{s}, \quad q = \xi_0^2(\tau). \qquad (3.5)$$

Thereupon one finally obtains

$$\frac{dq}{dp} = -12(1 - \sqrt{q}) + \frac{4q}{p}. \qquad (3.8)$$

This equation is investigated graphically. The following qulitative conclusions were reached: The viscous-plastic region expands at the beginning of the motion, until it reaches a maximum; then it decreases and finally vanishes. In all the cases, a certain part of the bar, adjacent to the free boundary, remains undeformed. In general,

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the integral formula obtained, requires numerical integration. The results of the integration are plotted for various values of Saint-Venant's parameter s. With large s, it is possible to give the solution explicitly. Formulas are obtained for the most important parameters: the maximum value of the viscous-plastic region and the total time of motion. The obtained approximate formulas yield satisfactory results with $s > 2$ already. The function $f(\xi)$ is plotted (for various s), representing the changes in the shape of the bar after impact. There are 7 figures.

ASSOCIATION: Institut mekhaniki Moskovskogo gosudarstvennogo universiteta (Institute of Mechanics of Moscow State University)

SUBMITTED: February 15, 1962

Card 5/5

S/020/62/144/004/006/024
B172/B112

AUTHORS: Ishlinskiy, A. Yu., Academician, and Barenblatt, G. I.

TITLE: Collision of a viscoplastic rod with a solid obstacle

PERIODICAL: Akademiya nauk SSSR. Doklady, v. 144, no. 4, 1962, 734-737

TEXT: The authors first show that the impact problem of a rod consisting of viscoplastic material, when considered quasi-unidimensionally (i.e. averaged over the cross section), can be described by the equation of heat conduction. Here, unlike in the classical problems of mathematical physics, the boundary to the domain of solution is independent of time. By a formulation based on the Kármán - Pohlhausen method of the boundary layer theory the problem is reduced to solving an ordinary differential equation. This formulation is such that instead of the differential equation a corresponding integral relation is satisfied. For very small and very high values of the Saint - Venant number a closed integration of the equation is possible. The results of numerical evaluations and of qualitative considerations are set out in several diagrams. Finally, it is shown how the changes in the shape of the rod can be calculated from

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L 10137-63 BDS

ACCESSION NR: AP3000901 S/0179/63/000/002/0193/0198 47

AUTHOR: Barenblatt, G. I.; Grigoryan, S. S.; Nikitin, L. V.; Salganik, R. L.

TITLE: On V. N. Nikolayevskiy's papers on the dynamics of fluid-saturated deformable porous media.

SOURCE: AN SSSR. Izv. Otd. tekh. nauk. Mekhanika i mashinostroyeniye, no. 2, 1963, 193-198

TOPIC TAGS: soil, porous soil, fluid-saturated porous soil, seismology, seismoelectricity, seismic petroleum exploration, Ya. I. Frenkel', M. A. Biot, acoustics, wave propagation, soil consolidation, ground water

ABSTRACT: This theoretical paper comprises a critique of articles published recently by V. N. Nikolayevskiy (Inzhenernyy zh., v. 2, no. 3, 1962; Akad. nauk SSSR, Izv., Otd. tekh. nauk., no. 5, 1962), in which Nikolayevskiy examines the fundamental problems of the dynamics of linearly deformed porous media saturated with a liquid. It is noted that in his first paper Nikolayevskiy makes no reference to Ya. I. Frenkel''s paper "On the theory of seismic and seismoelectric phenomena in a moist soil" (Akad. nauk SSSR., Izv., Ser. geogr. i geofiz., v. 8, no. 4

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ACCESSION NR: AP3000901

1944) and M. A. Biot's "Theory of propagation of elastic waves in a fluid-saturated porous solid, "Parts One and Two (J. Acoust. Soc. Amer., v. 28, no. 2, 1956) which are the fundamental classical treatises on this subject. In his second paper, Nikolayevskiy refers to these works by Frenkel' and Biot, but asserts that because (a) in their studies"...no account was taken of the need to fulfill the equations of the conservation of impulse of the entire system" and, also, because (b) "...of the simplifying assumption of constant density..." his basic equations differ from the basic equations of Frenkel' and Biot. The present paper shows that difference (a) is illusory, since under the simplifying assumption (b) the fundamental equations of both of Nikolayevskiy's works constitute a linear combination of the Frenkel' equations and that their physical interpretation as shown in N.'s papers is erroneous. It is also shown that the solutions of problems on the propagation of waves as adduced in N.'s two papers coincide with the solutions of the same problems already set forth by Ya. I. Frenkel' (loc. cit.) under the same simplifying assumptions (b) wherever N.'s solutions do not contain computing errors. The paper discusses the attempt made in N.'s second paper to take into account dynamic corrections in the ordinary theory of consolidation of a soil and shows its incorrectness. It is concluded that the difference of the fundamental relationships developed in N.'s two papers and the results of antecedent investigations consists in errors of a

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ACCESSION NR: AP3000901

fundamental and computational character committed by Nikolayevskiy. There are 18 numbered equations.

ASSOCIATION: none

SUBMITTED: 17Dec62 DATE ACQ: 12Jun63 ENCL: 00

SUB CODE: MA,AP,EL NR REF SOV: 007 OTHER: 001

Card 3/3

BARENBLATT, G.I. (Moskva)

Some boundary value problems for equations describing the percolation of liquids in fissured rocks. Prikl.mat.i mekh. 27 no.2:348-350 Mr-Ap '63. (MIRA 16:4)
(Soil percolation) (Boundary value problems)

ACCESSION NR: AP3003238 S/0040/63/027/003/0436/0449

AUTHORS: Barenblatt, G. I. (Moscow); Salganik, R. L. (Moscow)

TITLE: Splitting brittle bodies. Auto-oscillations in splitting.

SOURCE: Prikladnaya matematika i mekhanika, v. 27, no. 3, 1963, 436-449

TOPIC TAGS: splitting, brittle body, auto-oscillations, semi-infinite wedge, propagation of oscillations, lithium fluoride crystal, bismuth crystal

ABSTRACT: The authors develop a theory for the auto-oscillation process arising with splitting. The theory is based on the assumption that the modulus of cohesion --the basic characteristic of the forces exerted on the end of the crack--depends on the instantaneous velocity of propagation of the end of the crack, which at first decreases as the velocity increases. This decrease of the modulus of cohesion with increase in the velocity of propagation of the crack for quasi-brittle shattering in a wide class of materials is also related to decrease in nonelastic deformation in the surface layer of the crack. In accordance with experimental data it can be assumed that the splitting velocities in which auto-oscillations arise (at least for reasonable dimensions of the body being split) are those which are essentially smaller than the velocity of propagation of transverse oscillations. The assumption

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of a quasi-brittle nature of shattering means that, in splitting, a thin zone of nonelastic deformations is formed near the surface of the crack. The results make it possible to explain the occurrence of auto-oscillations for both crystalline and amorphous substances, in which there is the dependence K(v) (K is the modulus of cohesion, v is the velocity of the end of the crack). Very little is known about this dependence. From the experimental data on "stability" of splitting of certain crystals at high speeds one cannot even draw conclusions about the existence of a critical velocity for crystals. The oscillation amplitude of a length of free crack grows as the velocity of the wedge increases. Therefore, a smooth impact surface may be obtained not because of high velocity of splitting but because the oscillation amplitude of the length of free crack exceeded the dimensions of the crystal, so that the nonuniformity of motion of the end of the crack could not be noted on the length of the crystal. With increase in wedge velocity, the length of the wave increases until finally the surface of impact is not smooth. For crystals one would expect weak dependence K(v) rather than strong. On the other hand, for such substances as amorphous polymers, this dependence is evidently strong, and the presence of marked viscosity makes it possible to think that their critical velocity is small. In such materials, most of all there will be discontinuous relaxation oscillations with interruption of the end of the crack, characteristic for strong dependence K(v), having a minimum. Oscillations with interruption of the end of the

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crack (relaxational and nonrelaxational) evidently have a basic meaning. It may be that as a result of cold hardening, K will depend on the extent of the interruption. Here there is also an analogy with friction: the coefficient of friction may depend on the extent of contact of the rubbing surfaces. Orig. art. has: 6 figures and 35 formulas.

ASSOCIATION: Institut mekhaniki Moskovskogo universiteta (Institute of Mechanics, Moscow University)

SUBMITTED: 10Mar63 DATE ACQ: 23Jul63 ENCL: 00

SUB CODE: AP NO REF SOV: 009 OTHER: 005

Card 3/3

ACCESSION NR: AP4015966 S/0040/63/027/005/0784/0793

AUTHORS: Barenblatt, G. I. (Moscow); Cherny*y, G. G. (Moscow)

TITLE: Moment relations on surfaces of discontinuity in dissipative media

SOURCE: Prikl. matem. i mekhan., v. 27, no. 5, 1963, 784-793

TOPIC TAGS: moment relation, surface of discontinuity, dissipative medium, solid medium, narrow zone, continuous solution

ABSTRACT: In many cases the lack of continuous solutions for equations of motion within the model of a solid medium makes it necessary to introduce surfaces of discontinuity on which the characteristics of the medium and the motion are subject to jump-like changes. In mechanics of solid media surfaces of discontinuity are also used as a convenient approximation with respect to narrow zones where the motion or the medium has properties which are essentially different from the basic field. In either case one must satisfy conditions on the surfaces of discontinuity which make it possible to relate continuous solutions on both sides of the surface. Generally, these conditions mean physically the giving of a definite value of concentrated effects on the surfaces of discontinuity, or, in particular, the

ACCESSION NR: AP4015966

absence of concentrated effects on these surfaces. If the surfaces of discontinuity approximately represent relatively thin regions in which the motion or the medium has properties different from the basic field, then for determining the magnitude of the concentrated effects it is generally necessary to study the interior structure of these thin regions. Usually the dynamic conditions on the surfaces of discontinuity are derived from the laws of conservation of mass, energy, and impulse taken in integral form. For ideal media, the relationships of conservation of mass, energy and impulse in many cases yield a number of conditions on the surfaces of discontinuity necessary for determining the solutions. For dissipative media, single relations of conservation of mass, energy and impulse are insufficient; this occurs for viscous fluids. As additional conditions on the surface of discontinuity in the boundary layer of viscous, heat-conductive fluid, one can use conditions of continuity for the tangential component of velocity and temperature. The authors show that additional relations for a dissipative medium can be obtained as moment relations of rather high orders. In particular one can thus obtain conditions of continuity of velocity and temperature in viscous, heat-conductive fluid. The authors also show that in the boundary layer there is no surface of discontinuity for the longitudinal component of velocity. The lack of discontinuities for the tangential component of velocity is specific for Newtonian

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ACCESSION NR: AP4015966

viscous fluid; in other dissipative media such discontinuities may exist. The authors give an example of a dissipative medium in which the discontinuities of velocity, initially present, do not disappear instantaneously but decay exponentially with time. Analogous conditions can also occur for discontinuities of temperature. The obtaining of additional relations on surfaces of discontinuity is especially valuable for various models of media with a complex (including higher derivatives) structural dependence of stresses on deformations, velocities of deformations, etc. The importance of such models has grown with the appearance of a great quantity of new materials. "The authors, with sincere gratitude, mention the valuable advice given by L. I. Sedov in the discussion of these problems and the friendly attention of S. S. Grigoryan and R. L. Salganik to the work." Orig. art. has: 3 figures and 32 formulas.

ASSOCIATION: In-t mekhaniki MGU (Institute of Mechanics, Moscow State University)

SUBMITTED: 03Jun63 DATE ACQ: 21Nov63 ENCL: 00

SUB CODE: PH NO REF SOV: 004 OTHER: 002

Card 3/3

BARENBLATT, G.I. (Moskva); SALGANIK, R.L. (Moskva)

Self-oscillations occurring in the cleavabe of slender bodies. Prikl. mat. i mekh. 27 no.6:1075-1077 N-D '63. (MIRA 17:1)

BARENBLATT, G. I.; GORODTSOV, V. A.

"On the local structure of the developed plastic flow."

report submitted for 11th Intl Cong of Theoretical & Applied Mechanics & General Assembly, Munich, 30 Aug-5 Sep 64.

BARENBLATT, G.I. (Moscow); KOCHINA, P.Ya. (Novosibirsk); MIKHAYLOV, G.K. (Moscow)

"Basic problems of the theory of fluid motion in porous media"

report presented at the 2nd All-Union Congress on Theoretical and Applied Mechanics, Moscow, 29 January - 5 February 1964

BARENBLATT, G.I. (Moscow)

"Mechanism of brittle fracture"

report presented at the 2nd All-Union Congress on Theoretical and Applied Mechanics, Moscow, 29 January - 5 February

BARENBLATT, G. I. (Moskva)

Flow of gas-[illegible] mixtures in crumbling porous [illegible]. Izv. AN SSSR. Mekh. i mashinostr. no.3:47-50 My-Je '64. (MIRA 17:7)

APPROVED FOR RELEASE: 06/08/2000 CIA-RDP86-00513R000203610017-1"

"APPROVED FOR RELEASE: 06/08/2000 CIA-RDP86-00513R000203610017-1

[illegible], G. [illegible] ; GRIGORYAN, [illegible] ; [illegible]
[illegible]

[illegible] articles.
[illegible] mashinostr. no. [illegible]

APPROVED FOR RELEASE: 06/08/2000 CIA-RDP86-00513R000203610017-1"

BARENBLATT, G.I. (Moskva)

Some calculations for the specific surface of cracks formed in a solid body by dynamic action. PMTF no.4:75-77 Jl-Ag '64.
(MIRA 17:10)

ACCESSION NR: AP4027591 S/0040/64/028/002/0326/0334

AUTHORS: Barenblatt, G. I. (Moscow); Gorodtsov, V. A. (Moscow)

TITLE: Structure of microstress field of extended plastic flow

SOURCE: Prikladnaya matematika i mekhanika, v. 28, no. 2, 1964, 326-334

TOPIC TAGS: microstress, plastic flow, solid medium, ideal plastic body, homogeneity, isotropy, polycrystal, microinhomogeneity, random stress field, stress-deformation, linear elasticity

ABSTRACT: The authors find the spectral densities of the energy of form change and volume deformation to within constant dimension factors. In extended plastic flow there is a collection of microstresses with measurements from ℓ_1 up to a dimension of order of the average dimension of a grain d and less. The microstress field has the property of local isotropy and homogeneity. In an elastic interval of measurements and wave numbers the authors obtain an expression for the structure tensor of the microstress field and the spectral representation of the correlation tensor to within two universal constants. The results show that the idea of local isotropy and homogeneity and the cascade hypothesis, set forth by Kolmogorov in turbulence theory, are of great value for a wide class of nonlinear distributed systems with

ACCESSION NR: AP4027591

dissipation. "The authors are deeply grateful to A. S. Monin for his valuable advice and R. L. Salganik for his useful discussions." Orig. art. has: 38 formulas.

ASSOCIATION: none

SUBMITTED: 20Dec63 DATE ACQ: 28Apr64 ENCL: 00

SUB CODE: AP NO REF SOV: 005 OTHER: 002

Card 2/2

ACCESSION NR: AP4043285 S/0040/64/028/004/0630/0643

AUTHOR: Barenblatt, G. I.

TITLE: Some general notions of the mathematical theory of brittle fraction

SOURCE: Prikladnaya matematika i mekhanika, v. 28, no. 4, 1964, 630-643

TOPIC TAGS: brittle rupture, crack propagation, quasi brittle rupture, surface energy, intermolecular bonds

ABSTRACT: The results of studies of equilibrium and propagation of cracks in materials which were made during the last decade permit the formulation of the basic problems of the mathematical theory of brittle fracture in more general terms. In the analytical formulation of the brittle fracture for a given body and a given load, it is necessary to define the quantitative characteristics of brittle fracture which is being done in the present paper. Whatever the definition, the presence of cracks must be assumed, since the development of cracks is causing the brittle fracture. The complete solution of the problem of equilibrium is very difficult, and gives more information then practically needed. It is only essential to know whether or not the body can stand the load. Not in all cases

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ACCESSION NR: AP4043285

the development of a crack leads to rupture, and the strength of material does not depend, within certain limits, on the size of the initial cracks. Orig. art. has: 9 figures and 33 equations.

ASSOCIATION: Institut Mekhaniki, Moskovskogo Universiteta (Mechanical Institute, Moscow University)

SUBMITTED: 19Apr64

ENCL: 00

SUB CODE: MA, SS

NO REF SOV: 013

OTHER: 004

Card 2/2

L 16685-65 EWT(m)/EPF(c)/EPR/EWP(j)/T Pc-4/Pr-4/Ps-4 ASD(f)-2/ASD(m)-3 WW/
ACCESSION NR: AP5000275 RM S/0040/64/028/006/1048/1060

AUTHOR: Barenblatt, G. I. (Moscow)

TITLE: On the extension of the necked zone with stretching of polymer specimens

SOURCE: Prikladnaya matematika i mekhanika, v. 28, no. 6, 1964, 1048-1060

TOPIC TAGS: polymer, plastic deformation

ABSTRACT: A review of significant work dealing with necking phenomena in stretched polymers is presented. Attention is called to the fact that polymers stretched at a constant strain rate often show first, second, and even higher orders of necking. A photograph is included showing different stages of strain of a polymer specimen - a part of work carried out in the Plasticity Division, Institute of Mechanics, MGU, by V. I. Shobolova. The author expresses the opinion that polymer chain reorientation causes the succession of orders of necking in stressed polymers. A differential equation is derived describing the reorientation process in its relation to stress rate, strain rate, specimen (neck) cross section, and volume of reoriented material. Particular solutions are demonstrated with the imposition of limiting conditions and definition of new variables. Conditions determining a critical stress at which one order of necking terminates

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ACCESSION NR: AP5000275

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are described mathematically. A means of finding this stress from material descriptions and testing procedure is derived. The author cites the data from many scientists working in the same field, and expresses personal thanks to V. A. Kargin, S. A. Khristianovich, G. L. Slonimskiy, T. I. Sogolova, R. L. Salganik, and V. A. Gorodtsov for their attention to his work and for their valuable observations. Orig. art. has: 4 figures and 39 equations.

ASSOCIATION: Nauchno-issledovatel'skiy institut mekhaniki Moskovskogo universiteta (Scientific Research Institute of Mechanics, Moscow University)

SUBMITTED: 15Aug64 ENCL: 00

SUB CODE: MT NO REF SOV: 009 OTHER: 003

Card 2/2

BARENBLATT, G. I.

"The mathematical theory of brittle fracture."

paper submitted for Intl Conf on Fracture, Sendai, Japan, 1[illegible]-16 Sep 6[illegible].

Moscow State Univ.

L 62546-65 EWP(m)/EWT(1)/FCS(k)/EWA(d)/EWA(1) Pd-1
ACCESSION NR: AP5018201

UR/0207/65/000/003/0095/0096

AUTHORS: Barenblatt, G. I. (Moscow); Bulina, I. G. (Moscow); Myasnikov, V. P. (Moscow)

TITLE: Effect of some high molecular compound solutions on the lowering of drag of a body in a turbulent flow

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TOPIC TAGS: turbulent flow, polymer, glycerine, drag, boundary layer, experimental method, kerosene, water solution

ABSTRACT: Experimental investigations were made to determine the effect of polymer solutions on the drag of circular cylinders in turbulent flow. The experiments were carried out in open channels 1.2-m wide and 1-m deep. The cylinders were 40 mm in diameter and 400 mm long. The experiment was carried out first with the support sting without the cylinder, then with the cylinder but without the polymer, and subsequently with cylinder and support with different polymer concentrations. The polymers were carboxymethylcellulose, water solution of polyvinyl alcohol, and aluminum oil in kerosene with 0.5 to 10% concentration in water. At Reynolds numbers of 6.5×10^4, up to 34% reduction in drag was

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observed. It was discovered that for each type of polymer used there was an optimum concentration which reduced the drag to a minimum. No unique physical explanation could be found for the drag reduction. Some of the reasons cited are: the increased fluid viscosity moves the flow detachment point further downstream (as tested independently in glycerine); the lowering of turbulent pulsation intensity in the boundary layer; and a possible change in interaction between the flow and the cylinder surface. B. I. Isayev, L. S. Magaziner, Z. P. Titova, V. M. Tret'yakov took part in the experiments. The authors express their deep gratitude to them. The authors thank V. F. Shushpanov, Yu. L. Yakimov, L. I. Zhigachev, and A. I. Denisov for their kind assistance in the above experiments and Professor M. Tulin (Hydronautics, USA) for advice on the experimental operation. Orig. art. has: 1 table and 1 figure.

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